Sydney University
Graduate Medical Program Year 1

Heart Sounds Session
2016-2017

Dr Andrew Coggins
Emergency Medicine Consultant
Simulation Centre Instructor

Westmead Hospital
Cardiovascular OSCE

Initial Examination

- **Introduce** yourself and check the patient’s name
- **Consent** to examine and state you will maintain **Confidentiality**
- **Hand Hygiene** (wash hands or hand rub)
- **General Inspection**: Look all around the bed, comment on patient comfort, GTN spray, monitoring, cannula and fluid restrictions
- **Look at Hands**: Tar staining, cyanosis (peripheral), clubbing, splinter haemorrhages, tendon xanthomata and nail changes
  (NB Quinke’s Sign/Osler’s Nodes/Janeway lesions are rare)
- **Examination of the Radial Pulse**: Comment on rate and rhythm
  Compare with femoral and opposite radial (femoral/radial delay)
- **Measure** (or ask the examiner) for the **Blood Pressure**
- **Brachial Pulse**: Comment on the character of pulse
- **Look at the Face**: Especially look around Eyes and in the Mouth
  Note any jaundice, xanthelasma, malar flush, cyanosis or uraemia
- **Carotid Pulse**: Comment on the Character of Pulse
- **Jugular Venous Pressure (JVP)**: Examine at 45– to see this clearly
  you may need to press the abdomen (the **hepato-jugular reflex**)

**Chest Examination (Precordium)**

- **Inspection**: Comment on scars (pacemaker, bypass graft, valves)
- **Palpation**
  - Apex beat (is it displaced?)
  - Parasternal Heave
  - Palpable Murmurs (thrills)
- **Auscultation**
  - There are four main areas to cover (see page 3)
    - Mitral
    - Tricuspid
    - Aortic
    - Pulmonary
- **Lungs** - Auscultation of the posterior chest for fluid ‘overload’.
- **Look for** **Sacral** or **Leg Oedema** – comment on ‘pitting oedema’
- **State that you would like to examine in more detail the chest (dynamic auscultation), abdomen (liver) and urine (see page 3)**

*(PHOTOCOPY THIS PAGE AND TICK THE BOXES FOR OSCE PRACTICE)*

NB: never forget … go back to basics of Inspection, Palpation, Percussion and Auscultation if you get stuck in an OSCE…
Additional Cardiac Examination

- **Dynamic Auscultation:**
  1. Lean patient onto left side to increase chance of hearing low pitched mitral murmurs such as Mitral Stenosis
  2. Sit patient forward ask him or her to breathe fully out. Ask them to hold their breath. Listen with your stethoscope at the ‘left sternal edge’ for aortic murmurs. Soft aortic murmurs, especially Aortic Regurgitation may become louder at this stage
- **Abdominal examination** – large (*sometimes pulsatile*) liver in right sided heart failure. Enlargement of Spleen in Endocarditis
- **Urine** – microscopic haematuria may occur in Endocarditis
- Ask to view the **Observation Chart** for the Patient
- State you would want to consider further investigations (‘B.I.L.’):
  - **Bedside** (ECG, Blood Sugar), **Imaging** (CXR) and **Labs** (EUC and FBC)

**Summary**

In the cardiovascular examination having a well-practiced routine of your own is essential. A basic understanding murmurs and clinical signs are also important. Having said this, a degree of variability is acceptable in an examination (OSCE) and in clinical practice. The most important things are to treat the patient with care and consideration and to be systematic.
The Heart Sounds

1st heart sound (also known as ‘S1’ or ‘Lub’)
- This represents closure of mitral and tricuspid valves
- Splitting of the first heart sound(s) is normal on deep inspiration
- S1 may be ‘soft’ – this may accompany aortic or mitral regurgitation
- S1 may be ‘loud’ in mitral stenosis and in tachycardia

2nd heart sound (also known as ‘S2’ or ‘Dub’)
- Represents aortic and pulmonary valve closure
- This heart sound (S2) becomes ‘softer’ in aortic stenosis
- Loudness may be of no significance in any underlying disease process but may be associated with tachycardia or hypertension

Splitting of the Heart Sounds
- A degree of splitting is normal on deep breathing
- Reverse splitting of the sounds may occur (see page 14) in atrial septal defects. This is heard best by listening in the pulmonary area

Now listen to Recordings of Normal Heart Sounds:
http://solutions.3m.com/wps/portal/3M/en_US/Littmann/stethoscope/education/heart-lung-sounds/
Cardiac Physiology

Myocardial Blood Flow

The Cardiac Cycle

Cardiac Function

(For Cardiac Anatomy See Page 16)
3rd heart sound
- This is due to Rapid Ventricular Filling. It is best heard with the bell of your stethoscope - “Ken tuc-k-eee” gallop just after s2
- Suggests underlying pathology in those over 30 years.
- Often occurs where there is a dilated left ventricle or where there is poor left ventricular function. (e.g. post MI, cardiomyopathy, mitral regurgitation, ventricular septal defect)

4th heart sound
- Occurs due to a Stiff Ventricle and atrial contraction against it. (e.g. heart failure, aortic stenosis and hypertensive heart disease)
- “Ten – e – see” gallop. Occurs just prior to s1. (always abnormal)
The Pansystolic Murmur (PSM)
- Often due to Mitral or Tricuspid regurgitation
- The murmur may obscure S2 and S1 may be soft
- Ventricular Septal Defect (VSD), Patent Ductus Arteriosus (PDA) and Mitral Valve Prolapse may also produce systolic murmurs.

The Ejection Systolic Murmur (ESM)
- Common in children (30% innocent)
- The classic crescendo-decrescendo murmur
- Has a broad differential diagnosis in adults (e.g. Aortic Stenosis, and also Aortic Sclerosis, HOCM).
The Mid Diastolic Murmur (MDM)
- May be caused by Mitral Stenosis (MS)
- Typically a hard to hear low pitched rumbling murmur heard best with the ‘bell’ of the stethoscope in the left lateral position
- Classically due to Rheumatic Heart Disease (see page 10)
- Accompanying atrial fibrillation may reduce the murmur’s loudness

The Decrescendo Diastolic Murmur
- Classic ‘absence of silence in early diastole’ (see page 12)
- May be due to Aortic Insufficiency causing a high pitched murmur
- This is heard best by using ‘Dynamic Auscultation’ (see page 3): Sit the patient forward - on expiration listen at left sternal edge
The Significance of a Murmur (1)

Endocarditis

Endocarditis – This is a disease of the heart valves usually caused by a bacterial pathogen. Endocarditis can lead to non-repairable damage to heart valves and therefore can be the cause of a heart murmur. Endocarditis is likely to be the diagnosis (Dukes Criteria) where there are 2 major criteria, 1 major plus 3 minor criteria or 5 minor criteria present.

Major Criteria

(1) Positive blood culture for Infective Endocarditis
Typical Microorganism consistent with Endocarditis from 2 separate blood cultures:
• Viridans streptococci, *Streptococcus bovis*, or
• Community-acquired *Staphylococcus aureus* or enterococci, in the absence of a primary focus of infection

Or
Microorganisms consistent with IE from persistently Positive Blood Cultures
• 2 positive cultures of blood samples drawn >12 hours apart, or
• All of 3 or a majority of 4 separate cultures of blood (with 1st and last drawn 1h apart)

(2) Evidence of Cardiac Valve Involvement
Positive Echocardiogram for IE defined as:
• Oscillating intra-cardiac mass on valve or supporting structures, in the path of regurgitant jets, or on implanted material in the absence of an alternative anatomic explanation, or
• Abscess or New dehiscence of prosthetic valve

Or
New Valvular Regurgitation (*not worsening or changing of pre-existing murmur*)

Minor Criteria

(1) Predisposition
Predisposing heart condition or intravenous drug use

(2) FEVERS
Temperature > 38.0° C

(3) Vascular phenomena
Major arterial emboli, septic pulmonary infarcts, mycotic aneurysm, intracranial haemorrhage, conjunctival haemorrhages, and Janeway lesions

(4) Immunologic phenomena
Glomerulonephritis, Osler's nodes, and rheumatoid factor

(5) Microbiological evidence
Positive blood culture but does not meet a major criterion as noted above or serological evidence of active infection with organism consistent with Endocarditis

(6) Echocardiography
Consistent with IE but do not meet a major criteria
The Significance of a Murmur 2
Rheumatic Fever

Rheumatic Fever – This is an acquired disease and is thought to be an autoimmune consequence of Lancefield Streptococcus (group A) infection. Traditionally, this has been a leading cause of valvular heart disease but with the advent of antibiotics it is becoming less common. The various valvular lesions resulting from this disease can be a cause of an acquired heart murmur and of symptoms requiring medical or surgical intervention. The diagnosis is based on typical signs and symptoms as outlined below.

The Duckett-Jones Criteria

Major criteria
Carditis (50%)
Polyarthritis (60%)
Chorea (20%)
Erythema marginatum (5%)
Subcutaneous nodules (5%)

Minor criteria
Arthralgia
Fever
Elevated ESR or CRP
Prolonged PR interval
Evidence of preceding group A streptococcal infection (e.g. from positive throat cultures or rapid antigen testing)
Elevated or rising streptococcal antibody titre (ASOT)

Confirming the diagnosis can be controversial: Normally two major OR one major and two minor are necessary to suggest a diagnosis of Rheumatic Fever.
The Significance of an ‘Ejection Systolic’ Murmur

Aortic Stenosis

Aortic Stenosis – This is usually an acquired disease of the aortic valve affecting elderly patients but it can in rare cases be congenital. The disease is more common in those with a bicuspid valve. Aortic Stenosis leads to progressive narrowing of the aortic valve leading to haemodynamic changes in severe cases and symptoms such as syncope. Surgery is considered in symptomatic cases with gradients > 50mmHG.

- Features
  - Ejection Systolic Murmur
  - Murmur radiates to the carotid artery and is loudest in the Aortic Area.
  - There may be a narrow pulse pressure (e.g. 110/100)
  - Symptoms include Syncope, Chest Pain and Breathlessness

- Differential Diagnosis of an Ejection Systolic Murmur
  - Aortic Sclerosis (calcification with age)
  - Flow Murmur (e.g. anaemia)
  - Mitral Regurgitation, Pulmonary Stenosis
  - Hypertrophic Obstructive Cardiomyopathy (HOCM)
  - Atrial Septal Defect (ASD)

- Common Causes of AS
  - Endocarditis
  - Bicuspid Valve
  - Rheumatic Heart Disease
  - Degenerative

The loudness of the murmur in AS may have a degree of correlation with the severity but in very severe disease the murmur is often quiet.
The Significance of a Diastolic Murmur

Aortic Regurgitation

**Aortic Regurgitation (AR)** – Usually an acquired disease of aortic valve. Incompetence of the valve causes a regurgitant jet of blood in diastole.

- **Clinical Features**
  - Absence of silence in early diastole
  - De-crescendo Diastolic High Pitched Murmur
  - Large volume pulse
  - Collapsing pulse
  - Wide Pulse Pressure
  - Apex is displaced thrusting in character

- **Eponymous Signs**
  - Austin Flint Murmur – A mid-diastolic murmur representing the regurgitant jet hitting the opening mitral valve.
  - Corrigan’s Sign – Visible pulsatile carotid arteries
  - De Musset’s – Severe AR causing visible ‘head nodding’
  - Pistol Shot Femorals (Traube’s Sign) - Occluding the proximal artery causes gun like noise to be heard with stethoscope over the groin
  - Quinke’s Sign – This is visible nail bed pulsation
  - Duroziez’s Sign – Double murmur listening over femoral artery
  - Muller’s Sign – Visible Pulsation of the Uvula

- **Causes of Aortic Regurgitation**
  - Infective Endocarditis
  - Rheumatic Heart Disease
  - Aortic Root Problem (Marfan’s, Ehlers Danlos, Syphilis)
  - Ankylosing Spondylitis
  - Prosthetic Valve leak
  - Poorly Controlled Hypertension
  - Congenital Coarctation or Bicuspid Valve
The Significance of a Pan-systolic Murmur

Mitral Regurgitation

Mitral Regurgitation – This is an acquired disease of the mitral valve which can lead to progressive heart failure. With an incompetent valve a regurgitant jet passes back through the mitral valve instead of forward through the aortic valve in the systolic phase of the cardiac cycle.

Mitral Valve Prolapse – This is an acquired disease of the mitral valve occurring in young people. A ‘click’ is heard as the valve prolapses. The prolapse leads to valve incompetence and retrograde regurgitation.

- The Main Features of Mitral Regurgitation
  - Pan Systolic Murmur – tends to radiate from apex to axilla
  - Loudest in the Mitral Area
  - There may be a thrill/heave
  - Apex Beat may be displaced and is volume loaded (‘thrusting’)
  - Jerky Pulse
  - Signs of severity which would include left ventricular hypertrophy, soft S1, S3 and pulmonary hypertension.

- Causes
  - Degeneration
  - Left Ventricular Dilatation
  - Post Myocardial Infarction
  - Rheumatic Heart Disease
  - Connective Tissue
  - Mitral Valve Prolapse
  - Endocarditis
  - Post Valvotomy
  - Autoimmune
Other Important Murmurs and Sounds

- **Ventricular Septal Defect (VSD)**
  - This is a ‘hole’ between the right and left ventricle
  - VSD is characterised by a continuous pansystolic murmur
  - Heard best at left sternal edge - There may be a Thrill
  - Loud murmur = Less severe ; Quiet murmur = More severe
  - Most commonly congenital cause or post MI

- **Atrial Septal Defect (ASD)**
  - Wide fixed splitting due to delayed pulmonary valve closure
  - There may be a murmur but it is not usually due to the ASD but rather usually due to ‘flow’ across pulmonary valve

- **Tricuspid Regurgitation (TR)**
  - Classic features of TR include raised JVP with giant v waves, right ventricular heave and a pansystolic murmur
  - Murmur is loudest at the left sternal edge and louder on inspiration. Pulsatile liver and oedema are seen in severe cases

- **Hypertrophic Obstructive Cardiomyopathy (HOCM)**
  - Jerky Pulse
  - Systolic Murmur
  - Murmur is louder on standing and with a ‘valsalva' manoeuvre
  - Apex has a double impulse

**Ordered Stages of Pulmonary Hypertension**
- Loud P2 (later becomes palpable)
- Pulmonary Regurgitation
- Right Ventricular Heave
- Tricuspid Regurgitation
- Hepatomegaly and Pulsatile Liver
- Peripheral Oedema

**The Grading of Murmurs**
- 1 – Only heard when listening for a while
- 2 – Soft Murmur
- 3 – Clearly Heard, No thrill
- 4 – Audible with Thrill
- 5 – Heard with stethoscope barely on chest
- 6 – Heard with stethoscope off chest
## Homework Exercise

Write down Features of four Common Heart Murmurs…

<table>
<thead>
<tr>
<th>Features of Mitral Regurgitation</th>
<th>Features of Aortic Stenosis</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(What are ‘3 differentials’ of an Ejection Systolic Murmur??)</td>
</tr>
<tr>
<td>Features of Aortic Regurgitation</td>
<td>Features of Mitral Stenosis</td>
</tr>
<tr>
<td>Write a sentence (or two) about Tricuspid Regurgitation</td>
<td></td>
</tr>
</tbody>
</table>
ECG ANATOMY

AVR (Left Main Lead)

Anterior-septal Leads (Left Anterior Descending)

Inferior Leads (Right Coronary)

Lateral Leads (Circumflex)